Barnes

June 30, 2001

Mr. Wayne R. Warren, Chief
Division of Real Estate and Land Management
Ohio Department of Natural Resources
1952 Belcher Drive — Bldg. C-4
Columbus, Ohio 43224-1386

Dear Mr. Warren

Barnes Nursery, Inc. is in receipt of your letter of June 11, 2001 stating that ODNR objects to our Corps of Engineers permit application number 2000-02170(1) on the basis that our project is not consistent with certain policies of the Ohio Coastal Management Program (OCMP). Our firm will be appealing your formal notice of objection to our project to the Secretary of the United States Department of Commerce based on the grounds that our proposed activities are consistent with the objectives and/or purposes of the Coastal Zone Management Act. However, we would like to take this opportunity to respond to your comments and explain our East Sandusky Bay hydrology restoration project in more detail. We will demonstrate that this project is in harmony with OCMP policies and that when completed it will indeed enhance the environment and natural resources of this important coastal body of water.

Unfortunately you have made serious errors in labeling your figures and interpreting our intent which have led to faulty conclusions on your part. Please pay particular attention to where we have pointed out these errors. First, we would like to provide you with answers to the questions posed on pages 1 and 2 of your letter. The following responses correspond to your five questions:

Position of the "Canal"

The position of the hydrologic channel shown in Figure 1 of our application is essentially correct and is in general agreement with the orientation of the east northeast channel shown on your Figure A. However, your figure shows an extension of our project to the south at the southeastern end of the channel. This extension is not part of our application, but rather a preexisting intake channel. Additionally our Figure 1 shows the location of a proposed narrow feeder channel at the northeast end of the project which of course would not yet be present on the photograph in our Figure 5. The three-foot-wide feeder channel would only be the width of a pencil line if drawn to true scale, but is shown wider on our Figures 1 and 2 for ease of recognition. The actual dimension of the feeder channel is indicated in an adjacent note on Figure 2. Also your Figure A erroneously shows the position of the "overwash fan." Please note the accurate position on enclosed aerial photograph No. 347 (March 14, 2001)— the fan is considerably smaller and farther north than shown on your figure.

Understandably, it is difficult to match a 1979 USGS map (with 1969 topographic contours) with oblique aerial photographs taken in 2000 under various water level conditions. The south shore of East Sandusky Bay has receded landward since the USGS survey, thus the channel appears to cut across uplands on Figure 1, but in actuality the channel was excavated in open water. Because the bottom of East Sandusky Bay has very little relief and is so shallow, small differences in water elevation can produce dramatically different shoreline configurations. We were not provided with the dates or water levels for your photographs, but your Figures B and C were obviously taken on days with higher water levels than those shown in our Figure 5. For the above reasons the position of the channel may appear to be different on different photographs or maps, depending on such factors as water level, camera location and angle, and the relative time interval between when the photographs were taken or when the maps were drawn.

Mud Flat and Feed Channel Elevation

The elevation of the East Sandusky Bay bottom (or mud flat during low water levels) surrounding the Barnes Nursery project site lies 1.5 to 1.6 feet above Low Water Datum (LWD) which is equivalent to an elevation of about 570.8 (IGLD, 1985). Thus, a feeder channel 1.5 feet deep would have a bottom that lies at 0 to +0.1 feet LWD, which is an elevation of about 569.3 feet (IGLD, 1985). On page 2, paragraph 1, line 9 of our application, please correct "about 568.8 feet (-0.4 feet LWD) to read "about 569.3 feet (+0.1 feet LWD)." This discrepancy was corrected in our Ohio EPA Water Quality Certification Application No. 2000-02170(1) of May 25, 2001 (page 2, final paragraph).

Use of Term Avulsion

Glossary of Geology (Bates and Jackson 1980 American Geological Institute, Falls Church, VA) defines "avulsion" in reference to coastal areas as "rapid erosion of the shore by waves during a storm." The usage of the word avulsion for the same process is also found in *Waves, Tides, Currents and Beaches: Glossary of Terms and Standard Symbols* (Wiegel 1953 Council on Wave Research, The Engineering Foundation, Berkeley, CA). Certainly the devastating, single-storm, shore erosion event described by Carter (1973b *The November Storm on Lake Erie*. ODNR, Div. Geological Survey Infor. Circ. 39, Columbus, OH) was rapid and resulted from storm-wave attack. Thus, the term avulsion is an appropriate geological term to describe the process observed by Dr. Carter.

Bathymetric Profiles

In an original report on the impact of a 1972 high-water storm to the shore at the base of Cedar Point, the investigator's measurements were given in metric units. For the benefit of general readers and to be consistent with Corps of Engineers practice, the metric units were converted to Standard English units in our application. However, on page 6, paragraph 2, line 2 of our application, one of the measurements retained the metric units designation, although the number itself had been converted to the English unit equivalent. In this instance, please read "300 m" to be "300 feet." The remainder of this paragraph in our application is correct as stated.

Sawmill Creek

The 1901 USGS topographic map of Sandusky Bay (our Figure 7) shows Sawmill Creek flowing into the bay at its eastern end. The map also shows a series of open water lagoons and marshes that extend from the stream mouth westward to where the bay flares open near the tip of Cedar Point. The map shows most of the open water connected by northwest trending channels. Although some narrow marshes do not show a specific channel on the map, it is well known that coastal marshes transmit large volumes of water. For example, during years when the entire estuary of Old Woman Creek is a marsh covered with wetland plants, the entire flow of Old Woman Creek flows through the marsh. The calculated average flow through the estuary is nearly 5 million gallons per day (Buchanan 1983 *Transport and Deposition of Sediment in Old Woman Creek Estuary, Erie County, Ohio*. Ohio Sea Grant Tech. Bull. OHSU-TB-10-83, Columbus, OH).

J. Wager, a civil engineer, surveyed the eastern end of Sandusky Bay in August 1911 (see our Figure 20) and mapped a very distinct channel with a sinuous thalweg that flowed from the mouth of Sawmill Creek to beyond Big Island near the present Cedar Point causeway. He labeled this waterway "Black Channel." In the vicinity of our project he shows the channel to be approximately 250 feet wide and flowing through marshland, which he labeled both north and south of the channel. His map, as well as the 1901 USGS map, shows this channel being joined by a number of tributaries flowing from the south, including ones in the vicinity of the Barnes Nursery channel restoration project. The 1909 Erie County, Huron Township Plat Map (our Figure 18) also shows the channel of Sawmill Creek flowing through East Sandusky Bay.

Even without the foregoing supporting evidence, it is obvious that a stream the size of Sawmill Creek would require a sizable channel to accommodate its discharge. Sawmill Creek has a drainage area of approximately 18 km^2. Small streams in north central Ohio have an average discharge of 0.006 $m^3/sec/km^2$ (Buchanan 1983). In the case of Sawmill Creek, this equates to a discharge flow of 1,665 m^3 per day or 1.23 million gallons per day. The flow generated by this quantity of water discharge is most likely the origin and the sustaining factor for the Black Channel that once coursed through East Sandusky Bay.

Thank you for providing the historical perspective based on ODNR data. This information has been useful in understanding the changes that have taken place in East Sandusky Bay. Analysis of the ODNR data in conjunction with information derived from our investigations and other sources has permitted us to further interpret the changes that have occurred and to better assess the consequences of our proposed hydrology restoration project. To this end, we offer the following points for your consideration:

Fate of Black Channel

Classical studies of transgressing barrier bars (e.g. Johnson 1965 *Shore Processes and Shoreline Development*, Hafner Publishing Co., New York, NY) demonstrate that as a barrier bar migrates landward, the drainage channel on the inside of the bar also migrates landward to keep pace with the transgression. Figure 12 of our application illustrates this phenomenon. On Figure 15 of our Ohio EPA Water Quality Certification Application, Johnson's 1965 diagram has been modified with labels that show the time sequence of events that have taken place at the base of Cedar Point barrier beach and what will likely happen in the future.

The Johnson sequence normally takes place over an extended period of time. Unfortunately Cedar Point has been starved of beach-building sand by the Huron Harbor structures and other shore structures farther to the east. With very little new sand coming in from the east, the transgression process was accelerated to the point where the Black Channel could no longer keep pace and was overrun and filled. Likewise, sand starvation resulted in the rapid recession of the shore off the present mouth of Sawmill Creek to the point where the stream debouched directly into Lake Erie rather than following through Sandusky Bay. With the loss of Sawmill Creek's flow, Black Channel was more susceptible to infilling and was less able to adjust landward as the bar transgressed.

Statements made at the Corps of Engineers application public hearing on June 12, 2001 by several long-time residents of the area indicated that Black Channel was in existence until the Cedar Point barrier beach was breached by storms in the 1970s and 1980s. As pointed out in your review, the rapid retreat of the barrier beach at the base of Cedar Point (approximately 850 feet) during these storms destroyed much of the Black Channel between Willow Drive and Sheldon Marsh causeways.

Subaerial Exposure of East Sandusky Bay Bottom

Under average water level conditions in the vicinity of our project, East Sandusky Bay is an extensive open water environment, thus the bottom is a subaqueous environment. At mean lake level this part of the bay is covered with at least 0.7 feet of water (water level +2.2 feet LWD). However, during periods when the lake falls to below +1.5 feet LWD large expanses of bay bottom become exposed mud flats (subaerial environment). On these occasions, which were common during the past fall, winter and spring (2000-2001), the only water bodies in the bay were the remnants of the Black Channel southeast of Willow Drive causeway bridge and in the hydrologic channel we excavated in June and July 2000.

We agree that even if the Black Channel were reopened, the adjacent coastal wetlands above the sill elevation of the channel would not flood and would be subaerially exposed when the elevation of the lake drops below the sill. However, the ground water recharge capacity of coastal embayments is well documented and is one of the important values and functions of wetlands. Our hydrologic channel runs along the edge of coastal wetlands and thereby serves as a source of ground water for the adjacent wetlands. These wetlands benefit from the existence of the channel, particularly during dry, low-water periods. Water from our channel percolates laterally and saturates the soils beneath the adjacent coastal wetlands. Saturation of the root systems of wetland plants is essential for obligate species.

Channel on Landward Side of Cedar Point Bar

The elimination of Sawmill Creek flow into East Sandusky Bay appears to have taken place well before the major retreat of the barrier bar in the 1970s and 1980s, perhaps during the then record-high water levels of the early 1950s (see your Figure D). Without this flow, it is unlikely that "a deep, abandoned, channel" would have existed on the landward side of the barrier beach just prior to the major retreat. More likely the channel would have been 1 to 2 feet deep, similar to the remnant channel that still exists southeast of Willow Drive causeway bridge, with smaller tributary channels flowing from the south. High lake levels and the severity of the northeast storms are the most probable causes of the rapid retreat. Examination of the April 1987 aerial photograph of East Sandusky Bay (our Figure 11) shows no evidence of a deep channel in the wave height and refraction patterns that would be expected if such a channel still existed.

July 1986 Bathymetric Profiles

The bottom profiles recorded by the Ohio Geological survey in July 1986 were performed in water ranging in depth from 3.0 to 4.3 feet. The profiles were said to be run "across the wetland." Reviewing aerial photographs bracketing the survey period, and considering the depth of water in which the profiles were run, it is unlikely that any significant growths of wetland plants occurred along the profile lines. Open water embayment or lagoon, rather than wetland, would be a more accurate description of study area based on the lack of wetland plants.

The results of the profiles do show the existence of a shallow channel "just landward of the barrier" about 1.3 feet deep and an even shallower channel about 0.5 feet deep in the vicinity of our channel restoration project. These results are consistent with our interpretation as stated in the preceding point, "Channel on Landward Side of Cedar Point Bar" and which will be discussed under the point titled "Evidence of Channels in Excavated Channel."

1901 USGS Topographic Map

The USGS topographic sheet was published in 1901, but it is uncertain when the field mapping was done, what the water level was at that the time of the field mapping, or how detailed the mapping was for East Sandusky Bay. The civil engineer's map of 1911 (our Figure 20) gives a more detailed representation of the project area as it appeared in the early part of the last century. Nonetheless, your assumption that circulation via Lake Erie and the main part of Sandusky Bay may have been restricted historically when lake levels were extremely low is well taken. However a century ago, Sawmill Creek still flowed into the eastern end of Sandusky Bay, delivering some 450 million gallons annually to the bay based on the size of its watershed. This flow, plus water supplied from several small tributaries along the south shore, would have provided adequate circulation to sustain the coastal marshes in the east end of the bay even during periods of low lake level. By definition, wetland plants require saturated soils to grow and flourish. Thus, the fact that the 1901 map shows marsh vegetation throughout the east end of the bay, indicates that even under these conditions adequate water circulation was occurring in the bay to support wetlands.

Willow Drive Channel

Your letter states that Figure D shows a "channel system visible on 1937 aerial photographs" (page 3, line 9). However, the Figure D with your letter is a graph of "LAKE ERIE WATER LEVELS, 1860-2001." None of the figures in your packet contain a 1937 label.

As we have asserted in our application, certainly the construction of the causeways at Willow Drive and Sheldon Marsh State Nature Preserve have greatly altered the hydrology of East Sandusky Bay. While the bridge at the northern end of Willow Drive does permit a large flow of water to East Sandusky Bay (cross-section area as measured by our consultant on October 5, 1991 was 367 ft^2), the Sheldon Marsh causeway does not appear to have any functioning culverts. Thus, the large wetlands between the later causeway and Sawmill Creek are precluded from functioning as coastal wetlands.

The breaching of the barrier beach may, at times, permit additional water to flow into the east end of the bay, but under periods with sustained southwest winds (the dominant conditions for the region) water from the main part of the bay is drained directly to the lake through the breach, bypassing the east bay. Also during periods of falling lake levels, often associated with prevailing southwest winds, water from the east bay is sucked out through the breach, dewatering the bay bottom.

1968 Hydrologic Conditions

Your Figure E is labeled 1968. You contend that extensive vegetation is shown in this aerial photograph during water level conditions 0.5 feet higher than present levels. However, we suspect that this photograph is mislabeled and that indeed it was taken in 1937, a period when lake levels were at or near their all-time record low. The mid 1930s were the "dust bowl" years when the Great Lakes were extremely low for several years prior to 1937. Thus, during such extreme conditions the East Sandusky Bay bottom would be expected to vegetate over, but not under the conditions prevalent in 1968. By referring to Figure 10 of our application (changes in the position of the barrier bar from 1937 to 1968 drawn from aerial photographs) it is obvious that Figure E is not a photograph taken in 1968, indeed it was taken before the NASA pumping station was constructed during World War II.

Evidence of Channels in Excavated Channel

As indicated earlier in this document, the high-water storms of the 1970s and 1980s most likely resulted in the final destruction of most of the Black Channel between the Willow Drive and Sheldon Marsh State Nature Preserve causeways as the barrier bar transgressed the east end of the bay. The 1987 aerial photograph (our Figure 11), clearly shows waves entering the interior of the bay. Fine-grained sediments were eroded at this time (note the dark organic sediments being exhumed by the waves), with silt being carried into the bay. As a consequence the Black Channel was either over run or filled with sediment. The results of this process can be seen in our Figure 21 and the accompanying aerial photograph No. 347 (March 14, 2001). A series of five black sediment patches occur along the length of the side-cast island north of the hydrology channel. These represent former waterways that were part of the Black Channel system. They may represent a sinuous east-west channel, or more likely small tributaries flowing into the Black Channel from the south. The latter possibility is supported by dark lineaments in the soils, south of the hydrologic channel, which line up with the patches on the island. The positions of the former channels through the island correspond to where we propose to place the new cuts.

Revegetation of East Sandusky Bay Bottom

As discussed earlier in this document, the record-low lake levels of the mid-1930s, resulted in East Sandusky Bay to be dewatered for several years, permitting vegetation to spread across the bottom. However, it is unlikely that similar conditions existed in 1968. We suspect that your Figure E is mislabeled, and therefore your interpretation and conclusions regarding vegetation in East Sandusky Bay during 1968 are erroneous. We suggest you compare your Figure E with aerial photographs from the mid-1930s to determine the correct date.

Concluding Statement

We agree that East Sandusky Bay, especially the portion encompassed by Sheldon Marsh State Nature Preserve is a good example of a coastal wetland embayment protected by a barrier bar system. The protection provided by this bar and the hydrologic circulation within the bay are the prime reasons that the wetland has flourished. However, the deterioration and retreat of the bar in recent decades, accelerated by the deleterious effect of coastal construction projects, has placed the future existence of the east bay in peril.

Specific action needs to be taken to reverse this trend. The bar needs to be stabilized and caused to regress to its former (pre-breach) condition. At the same time the bay's hydrologic circulation needs to be restored. Circulation can be greatly enhanced by creating additional openings in the Willow Drive causeway and eliminating or bridging the Sheldon Marsh causeway. We believe that our proposed project will go a long way to restoring circulation that has been lost to the east bay caused by numerous artificial alterations.

You point out that constructing a channel in East Sandusky Bay, particularly through a dedicated State Nature Preserve is prohibited by State law. However, our position is that restoring the natural circulation that has been destroyed by artificial means would not violate the spirit of the law. Our project will indeed help reestablish the former natural hydrology of the bay. As such this action would not be prohibited under O.R.C. Section 1517. If this were not the case, then projects such as the one proposed with the U.S. Army Corps of Engineers to protect the barrier beach would also be prohibited.

Your letter indicates that ODNR objects to our project because it is not consistent with the policies of "OCPM." We believe you meant to state "OCMP" for the Ohio Coastal Management Program. Your letter enumerates eight policies for which concerns are stated. We would like to take this opportunity to address each concern and demonstrate how our proposed project is consistent with OCMP policies.

Policy 2 – Shore Erosion Control

Our proposed project is consistent with this OCMP policy because shore erosion control is not a design feature of this project. Three sections of our application are relevant to the ODNR concern that a shore erosion control structure permit be obtained for the proposed project:

Section 19. Nature of Activity – no reference to erosion control is mentioned in this section.
Section 19. Proposed Project Purpose – no reference to erosion control in this section.
Section 20. Reason for Discharge – the primary purpose of the discharge of dredged material, as stated is "to form a series of islands." As specified in Sections 18 and 19, the main purposes of these islands are "to foster wetland plant zonation," and for "creating avifauna habitat." In Section 20, secondary purposes are listed which include "erosion control from waves" and "retard sediment infilling of the hydrologic channel." We specifically do not refer to "shore" erosion control. Our statement in Section 20 should be taken to mean control of subaqueous erosion relative to the channel, not shore erosion. Our objective in this regard is to control the mobilization of sediments on the bottom of the bay that might be deposited in the hydrologic channel. The islands will be stabilized by planting native herbaceous and woody plants and establishing a sand beach on the bay side. This will preclude the need for hardening the shore with objectionable, unnatural rip rap. Because the islands afford siltation protection and because no sediment-laden tributaries empty into the hydrologic channel, maintenance dredging should not be required.

Therefore, because the islands have other primary purposes and because their design is not for shore erosion control, we do not believe that O.R.C. 1521.22 applies to our application.

Policy 6 – Water Quality & Policy 17 – Dredging and Dredged Material Disposal
Our proposed project is consistent with these OCMP policies by "enabling the use of the State's coastal waters for agricultural needs" while not impairing water quality. No dredging or disposal of dredged material has or will take place in wetlands, other than the restored intrusion that is described below.

On May 25, 2001, Barnes Nursery, Inc. submitted an application for a Section 401 Water Quality Certification for our project to the Ohio Environmental Protection Agency. Our response to several inquiries (Nos. 8a, 8c, 10a, 10b, & 10f) which are relevant to ODNR's concerns are summarized here.

Pursuant to Nationwide Permit No. 27 (2000-02170), issued by the U.S. Army Corps of Engineers to Barnes Nursery, Inc. on June 20, 2000, most of the work proposed in elements No. 1 and No. 2 of our current application was completed in July 2000. At the distal (west) end of the hydrologic channel, construction had encroached about 130 feet in an emergent wetland and a mound of earth about 10 to 15 feet high was stock-piled at the distal end of the island. Work on the project was halted in July 2000 before it could be graded to project height. In April 2001 the Corps of Engineers authorized restoration of the encroached wetland. This restoration work was completed on April 19, 2001 by refilling approximately 200 feet of dredged channel and reducing the earthen mound to its original topography.

No additional discharge of dredged material is anticipated for this project. Material excavated from the existing island to create the archipelago will be placed on the islands to the north (lakeward) side of the channel. The islands will serve several purposes: (1) provide erosion control for the channel from waves generated in East Sandusky Bay and Lake Erie during periods of barrier bar overtopping, (2) retard sediment infilling of the hydrologic channel, (3) foster establishment of a diverse wetland plant community by adding approximately 4,000 feet of shoreline to the bay (sloped to provide the proper gradient for plant zonation to occur), and (4) create high-quality, isolated avifauna habitat in a low-disturbance environment. The formation of a sandy beach front on the north side of the island, which has already begun to occur, will foster use by shorebirds which may include the piping plover (*Charadrius melodus*). The shore could be further enhanced for this purpose by the placement of additional sand from an external source. Barnes Nursery, Inc. pledges to undertake such a beach nourishment initiative and an unwanted bird species control program with the planning and direction of critical species habitat specialists of the U.S. Fish and Wildlife Service and animal damage control specialists of the U.S. Department of Agriculture, National Wildlife Research Center.

The work required to complete the project, as described in the application, will involve construction in the open water of East Sandusky Bay. No dredged material will be discharged to the surface waters of the bay. Material removed from the existing island, to grade the slopes and form the archipelago, will be placed above ground on the islands. A silt-barrier fence was installed for the wetland restoration component of this project. A similar deployment may be necessary during the island archipelago and shore grading components of the project. The need for other water pollution control measures is not anticipated.

Because the island is composed of ancient lacustrine sediments, minimal human contamination is anticipated. Minimal water discoloration is anticipated during the construction period, which should require no more than three days. Any turbidity resulting from this work should dissipate rapidly and be within the normal turbidity ranges expected from natural processes such as wave dissipation and fish spawning activity. This project will adhere to the State's antidegradation policy as it applies to agricultural practices.

To address concerns that our project will draw off water that would normally continue to flow eastward into Sheldon Marsh, we have analyzed the hydrologic circumstances of this portion of Sandusky Bay and have computed the water balance for various lake levels. East Sandusky Bay (between the Willow Drive and Sheldon Marsh causeways) has a surface area of approximately 290 acres (12,660,000 square feet) as calculated from USGS topographic maps. The bottom of East Sandusky Bay is virtually flat and lies at an elevation of 570.7 feet (IGLD, 1985) or 1.5 feet above Low Water Datum (LWD), rising slightly to an elevation of +1.6 feet LWD at the project site. As recorded by the Ohio Geological Survey (OGS), the long-term mean water level in Sandusky Bay is 571.4 feet in elevation or +2.2 feet LWD. OGS has calculated that on average, Sandusky Bay experiences a daily water level fluctuation of 0.6 feet (Donald Guy, personal communication). The major sources of water flowing into East Sandusky Bay are (1) the main portion of Sandusky Bay via the Willow Drive bridge opening and (2) directly from Lake Erie via the breach in the Cedar Point sand spit at Point Retreat. Minor contributions of water to the East Bay also come from surface runoff, tile drains, and small tributary ditches.

The fluctuations of water level in Lake Erie and Sandusky Bay are primarily wind induced surges, winds tides, or seiches. As the water level in Lake Erie or Sandusky Bay rises above the water level or bottom in East Sandusky Bay, water flows into the East Bay until it has equalized with the larger bodies of water surrounding it. Conversely, as the water level in Lake Erie or Sandusky Bay drops below the water level in the East Sandusky Bay, water flows out of the East Bay until it has either equalized with the larger bodies of water or it has been drained dry.

At the project site, the existing berm island is approximately 1,500 feet long and 50 feet wide, yielding an area of 75,000 square feet or 1.7 acres. This equates to less than 0.6% of the bottom of East Sandusky Bay. The existing dredged channel at approximately 1,500 feet long, 5 feet deep, and 40 feet wide with a 2 to 1 side slope, can hold 262,500 cubic feet or 1,962,500 gallons of water. This equates to less than 3% of the water volume of East Sandusky Bay at mean water level.

The following table shows the volume of water entering East Sandusky Bay for each 0.1 foot rise in water level and the corresponding percentage of water that could be held in the irrigation channel if filled to capacity:

Water Level (feet LWD)	Water Depth (feet)	Water Volume (cubic feet)	Water Volume (gallons)	Channel (%)
+1.5	0.0	0	0	
+1.6	0.1	1,266,000	9,469,680	20.7
+1.7	0.2	2,532,000	18,939,360	10.4
+1.8	0.3	3,978,000	29,755,440	6.6
+1.9	0.4	5,064,000	37,878,720	5.2
+2.0	0.5	6,330,000	47,348,400	4.1
+2.1	0.6	7,596,000	56,818,080	3.3
+2.2 [mean]	0.7	8,862,000	66,287,760	3.0
+2.3	0.8	10,128,000	75,757,440	2.6
+2.4	0.9	11,394,000	85,272,120	2.3
+2.5	1.0	12,660,000	94,696,800	2.1
+2.6	1.1	13,929,000	104,166,480	1.9
+2.7	1.2	15,192,000	113,636,160	1.7
+2.8	1.3	16,458,000	123,105,840	1.6
+2.9	1.4	17,724,000	132,575,520	1.5
+3.0	1.5	18,990,000	142,045,200	1.4

Considering that the mean daily water level fluctuation in Sandusky Bay is 0.6 feet, this equates to a mean daily exchange of water between East Sandusky Bay and the adjoining larger bodies of water of nearly 7,600,000 cubic feet or over 28 times the volume of water held in the channel. Even with a minimal 0.1 foot rise in water level, about 5 times as much water enters East Sandusky Bay as can be stored in the channel.

Essentially the water level in East Sandusky Bay is controlled by the forcing function of the water level in the larger adjoining bodies of water. Therefore, a depression within East Sandusky Bay will not govern the water level in East Sandusky Bay nor will it influence the distribution of water to various portions of the bay. The elevation of the bay bottom in relation to lake level dictates whether the bottom is covered with water or not. Because the sill at the channel intake is about 0.1 feet above the common bottom of the East Bay, water will not drain into the channel when water levels in the lake are below the bay threshold.

Also, concerns have been raised about the need for continued maintenance of the proposed feeder channel. Our position is that the natural oscillation of bay water levels would create adequate velocities in the channel to keep it open. To support this contention, we have determined velocities in the feeder channel, under various water level heads, and related them to sediment transport capabilities.

Our calculations relate to water flowing from the open lake, through the feeder channel, to the reservoir (hydrologic) channel and conversely, from the reservoir channel to the open lake. Water levels in Sandusky Bay continually oscillate with a mean daily excursion of about 0.6 feet. Thus, on average this produces a hydraulic head of 0.6 feet first on one side of the feeder channel, say on the lake side as the lake rises, then a head of similar magnitude on the reservoir channel side of the feeder channel as the lake falls.

Torricelli's equation can be applied to determine the velocity in the feeder channel under various head conditions. The lake can be considered a reservoir with an opening in its side (the feeder channel). Torricelli's theorem states that the velocity of water through the opening is equal to the square root of the product of two times the acceleration due to gravity times the head (Henke 1966 *Introduction to Fluid Mechanics*, Addison-Wesley Publ. Co., Reading, MA, p. 57). The following table shows the calculated velocity in the feeder channel for various hydraulic heads from 0.1 to 1.0 feet at either the lake side or reservoir channel side of the feeder channel:

Hydraulic Head	Velocity	
(feet)	(feet/sec)	(cm/sec)
0.1	2.5	76
0.2	3.6	110
0.3	4.4	134
0.4	5.1	155
0.5	5.7	174
0.6	6.2	189
0.7	6.7	204
0.8	7.2	219
0.9	7.6	232
1.0	8.0	244

Hjulström (1935 *Studies of the Morphological Activity of Rivers as Illustrated by River Fyris*, Upsula Univ., Sweden, Geol. Inst. Bull. V. 25, p. 295; and 1939 *Transportation of Detritus by Moving Water*, in P. D. Trask, ed., *Recent Marine Sediments*, Am. Assoc. Petroleum Geologists, Tulsa, OK, p. 10). has developed a classical, and well accepted, graph which predicts the velocities required to place loose particles in motion and transport them in a channel for different size grades of sediment. The offshore sediments in Sandusky Bay are dominated by silt-sized particles, with lesser amounts of clay and sand (Shaffer 1951 *Shore erosion on Sandusky Bay*, Ohio Journal of Science 51(1): 1-5. [reprinted in 1968 by Ohio Department of Natural Resources, Division of Geological Survey as Report of Investigations No. 7], p. 3; and U.S. Army Corps of Engineers 1953 *Ohio Shore Line of Lake Erie, Sandusky Bay, Ohio, Beach Erosion Control Study*, Appendix IV. 83rd Congress, First Session, House of Representatives Document No. 126, p. 8). The threshold velocities to mobilize and transport sediment particles of these size grades are shown below:

Particle	Median Diameter (microns)	Threshold Velocity for Sediment Mobilization (cm/sec)
Clay		
Medium	1	150
Coarse	2	100
Silt		
Fine	4	75
Medium	8	50
Coarse	31	20
Sand		
Fine	62	17
Medium	250	15
Coarse	1000	20

Thus it can be seen that the Torricelli or "jet" effect developed in the feeder channel with a minimal head of about 0.4 feet will be sufficient to keep the channel clear of deposited clay particles. A head of less than 0.2 feet will generate velocities great enough to keep silt and sand from being permanently deposited.

An alternative approach is to use the Chezy-Manning formula (Zilly 1975 *Handbook Of Environmental Civil Engineering*, Van Nostrand Reinhold, New York, NY, p. 520-522). Assuming a channel roughness factor of 0.013 to 0.017 for a straight, uniform earth channel (Newson 1994 *Hydrology and the River Environment*, Clarenden Press, Oxford, England p. 23) the following velocities are obtained for various hydraulic heads:

Hydraulic Head		Velocity	
(feet)	(slope)	(feet/sec)	(cm/sec)
0.1	0.0002	1.7	51
0.2	0.0004	1.9	58
0.3	0.0006	2.1	64
0.4	0.0008	2.3	70
0.5	0.0010	2.5	76
0.6	0.0012	2.7	82
0.7	0.0014	2.9	88
0.8	0.0016	3.1	94
0.9	0.0018	3.3	101
1.0	0.0020	3.5	107

In this approach it can be seen that the slope created by a head of 0.5 feet is required to remove settled silt and sand from the feeder channel, whereas a head of 1.0 feet or greater would be needed to erode the clay from the channel bottom. However, because clay-sized particles stay in suspension even under very low velocities (<0.1 cm/sec), no deposition of particles in this size range would be anticipated in the feeder channel.

In summary, the foregoing calculations indicate that the normal water level fluctuations in East Sandusky Bay are sufficient to create the hydraulic heads and attendant velocities necessary to maintain a free and clear feeder channel. Thus, no maintenance dredging will be required under typical conditions. However, devastating storms, such as those experienced in 1972 and 1987, could reconfigure or destroy the feeder channel.

Policy 8 – Nonpoint Source Pollution & Policy 12 – Wetlands

Our proposed project is consistent with this OCMP policy, particularly management measures 8.3.1 and 8.3.2 (Protection and Restoration of Riparian Areas and Wetlands). *Glossary of Geology* (Bates and Jackson 1980) defines riparian land as "situated along or abutting upon a stream bank." Because our project is located on East Sandusky Bay, an embayment of Lake Erie rather than a flowing stream, it would be more accurately described as "littoral" instead of "riparian." However, the wetland aspects of this policy do apply to our project.

Our project will provide protection to adjacent wetlands by forming a quiescent water body between the islands and the coastal wetlands along the south shore. As discussed earlier, the hydrologic channel will supply water for groundwater recharge to these wetlands during low lake level intervals. Our East Sandusky Bay hydrology restoration project will result in approximately five acres of new emergent wetlands to occupy the barren mud bottom between the present wetland border and our hydrologic channel. Because the interior slope of the islands will be graded to a gentle 4 to 1 slope (run to rise) they will foster the development of a diverse zonation of hydrophytic plants along 1,500 feet of shoreline. As described earlier, a small intrusion of approximately 0.3 acres into coastal wetlands was made as the project was constructed in July 2000. Although this intrusion was permitted under the Corps of Engineers permit that was in effect at the time of the construction, as a good faith effort, with the Corps approval, Barnes Nursery, Inc. restored the intruded area to its original topography in April 2001 .

The project area, as specified in our current application, constitutes an open water environment lacking any wetland plants and is typically submerged by the waters of Sandusky Bay. The boundary of coastal wetlands at the project site is delineated on our Revised Figure 2 (Figure 6 of Ohio EPA Water Quality Certification application). To resolve the question of wetlands verses mud flats verses open water environment, we have taken average conditions to be typical of the site. Under these conditions the project area is submerged and no emergent, submersed, or floating-leafed aquatic plants are present.

The long-term mean water level of Sandusky Bay as recorded at the ODNR, Division of Geological Survey gaging station in Sandusky is +2.2 feet above low water datum (LWD) or elevation 571.4 feet (IGLD, 1985). For reference, the water level during the agency site visit (May 22, 2001 at 2:00 PM) was +2.1 feet LWD, or elevation 571.3 feet, very close to the mean or normal water level in East Sandusky Bay. The general elevation of the bottom of East Sandusky Bay is +1.5 feet LWD and about +1.6 feet LWD at the project site. The indicates that under normal (mean) conditions, the water depth at the project site prior to construction was at least 0.6 feet.

Based on these data, our position is that the project area constitutes an open water environment. The mud flat in East Sandusky Bay that has periodically appeared in recent years is the result of abnormally low lake levels and should not be taken as typical or normal conditions. Because the project was constructed in an open water environment, we do not believe that further wetland or mud flat restoration/mitigation efforts are appropriate for this project.

Under the "Discussion" heading on page 5, you make the statement that the Sheldon Marsh "wetland is hydrologically unrestricted with no lakeward or upland border alterations." This statement is not accurate. Firstly, ODNR, Division of Natural Areas and Preserves (in conjunction with NASA, Plum Brook Station) maintains and has enlarged a 3,000-foot-long causeway that totally restricts natural drainage and connectedness with several coastal zone marshes along the east side of the Nature Preserve. Thus the upland border is most definitely restricted. Secondly, the western border of the wetland complex is severely restricted by the stone rip rap causeway that supports Willow Drive. Thirdly, the NASA pumping station at the Northeast corner of the Preserve is armored with large dimension stone capped with concrete and protected by massive cells of steel sheet piling that were driven into the barrier beach. To say that these imperious structures do not restrict hydrologic circulation is nonsense.

Conversely, our proposed project calls for six hydrologic openings along the 1,500-foot length of our project to insure free circulation. Connection between coastal marshes and the lake is essential to the viability of the wetlands—this feature is a keynote of our design.

You also state on page 5, "Activities conducted by the applicant have already adversely affected Sheldon Marsh State Nature Preserve." However, you neglected to specify in what way our project has adversely affected the Preserve. Without any specific information it is impossible for us to address this statement in any meaningful way.

In summary, it can be seen that our proposed project will both protect and enhance existing wetlands, will create new wetlands, and restore damaged wetlands without intruding existing marshes. Because of the unrestricted circulation design of the project and its location beyond the border of existing wetlands, no adverse impact to the adjoining marshes is foreseen. By restoring all disturbed coastal wetlands to their pre-existing condition, we believe we are now in compliance with the State's wetland policy. By creating at least five acres of new wetlands and 1,500 feet of additional wetland shore on a non-vegetated, bay bottom, we are supporting OCMP's policy to "where feasible, restore and create wetlands to increase the State's wetlands base."

Policy 14 – Rare and Endangered Species

Our proposed project is consistent with this OCMP policy by providing additional habitat for rare and endangered plant and animal species. The project lies on about 3.5 acres of East Sandusky Bay bottom (about 1% of the bay's bottom), but protects over 5 acres of bottom that would normally be exposed to storm action if not for the project. This protected area will form a quiescent refuge were shorebirds can forage during rough conditions in the bay and where state-listed rare wetland plants (annuals and low in stature) can thrive.

As discussed earlier, the formation of a sandy beach front on the north side of the island, which has already begun to occur, will foster use by shorebirds which may include the piping plover (*Charadrius melodus*). The shore could be further enhanced for this purpose by the placement of additional sand from an external source and at the same time help stabilize the island's bay shorelines. Barnes Nursery, Inc. offers to cooperate with the U.S. Fish and Wildlife Service and the U.S. Department of Agriculture, National Wildlife Research Center in formulating and undertaking a beach nourishment initiative and an unwanted bird species control program that would create additional plover habitat in East Sandusky Bay. The island habitat would be far less susceptible to open-lake wave attack than the barrier beach to the north.

One adult and four immature bald eagles (*Haliaeetus leucocephaus*) and two tundra swans (*Cygnus columbianus*) have been seen in the vicinity of the island and in the hydrologic channel. On June 12, 2001, during a Corps of Engineers site visit, a bald eagle landed on the island and was observed feeding on a bullhead (*Ameiurus* sp.) that had been captured in the adjacent channel. When Corps biologists approached the eagle took flight and landed in a large cottonwood tree that overhangs the restoration area. During the same site visit Corps biologists observed and photographed a threatened species of tiger beetle (*Cicindela hirticollis*) near the crest of the island.

Policy 15 – Exotic Species

Ohio DNR, Division of Natural Areas and Preserves, manages Sheldon Marsh State Nature Preserve which is located adjacent to the proposed project. Discussions have been held with Preserve personnel and a coordinated plan has been formulated with Mr. Gary Obermiller, District Preserve Supervisor, for the control of invasive plant species, particularly common reed (*Phragmites australis*) and purple loosestrife (*Lythrum salicaria*). The first phase of this plan will be a cooperative effort to chemically control invasive plants on the peninsula at the western end of the project. The northern, undisturbed portion of the peninsula lies within Sheldon Marsh State Nature Preserve, whereas the central portion (the area where wetland restoration was completed in April 2001) is in private ownership. The undisturbed southern portion of the peninsula is also held in private ownership. Both the northern and southern portions are heavily infested with *Phragmites australis* and have substantial growths of *Lythrum salicaria* as does much of the adjacent shoreline of East Sandusky Bay (see our application for Ohio EPA Water Quality Certification, Figure 16). Invasion of the restored area by these undesirable plants has already begun, therefore a cooperative control program will benefit both the State Nature Preserve and the project area.

This plan was approved in the field, at the project site, by the Corps of Engineers on May 22, 2001. We intend to use this invasive plant control effort on the restored area as a pilot study to limit the spread of *Phragmites australis*. If successful, this effort can be extended to control invasive plant species along the entire island archipelago. Thus, we believe our proposed project is consistent with OCMP policy by our efforts to "control exotic species to preserve the balance and diversity" of the East Sandusky Bay ecosystem.

Fortunately very little *Phragmites* has been observed on the island. Observations on June 27, 2001 revealed that lush growths of smartweed (*Polygonum* spp.) and other desirable native plant species are vegetating the island. The densest growth patterns correspond to the five former Black Channel patches that are shown on enclosed aerial photograph No. 347 (March 14, 2001).

Policy 26 – Preservation of Cultural Resources

Archaeological Site. Figure G, attached with your letter shows an archaeological site in the vicinity of our project. This site, 33-ER-436 is located to the south and west of our project. The site produced only one artifact — a slate, notched, butterfly bannerstone. The artifact was recovered during a survey of the site in September 1986. A preliminary documentation form for the site, prepared by Mr. Eugene Edwards and Dr. Jonathan E. Bowen, was received by the Ohio Historic Preservation Office on May 25, 1994. Mr. Edwards was contacted by Barnes Nursery on June 21, 2001 to inquire as to the specific location of the site and any other archaeological information that he could make available. Mr. Edwards visited our project site on June 22, 2001 and conducted a survey of the island and surrounding area. A report of his findings was submitted to the Ohio Historic Preservation Office on June 29, 2001.

In summary, site 33-ER-436 is located on upland property south of our project (the exact location of site is shown on an aerial photograph contained in Mr. Edwards' report, but not included herein in order to preserve the integrity and security of the site). His survey of the island and environs yielded no specific artifacts, only a few pieces of broken flint. No artifacts other than the bannerstone have been found at site 33-ER-436, although Mr. Edwards has surveyed the site on several occasions. He concluded that our project does not adversely impact site 33-ER-436 or any other archaeological site. He believes that the construction of our project may help protect site 33-ER-436 from destruction by the rapidly receding south shore of Sandusky Bay.

Floodplain. In the early stages of our project, we discussed our plans with the local floodplain administrator for Erie County, Ohio. Because the project was being undertaken pursuant to a Corps of Engineers Nationwide permit in an open-water situation and because no developemnt was involved in the project, no local permit was deemed necessary. However, following receipt of your letter we contacted Mr. Alex MacNichol, Director of the Erie County Planning Commission to discuss any authorizations that may be required by virtue of our project being located within the 100-year floodplain of Sandusky Bay. If any authorization is required we will of course take the necessary actions to comply with specific development standards and/or permits.

Water Withdrawal Facility. Pursuant to your inquiry, on June 14, 2001 we submitted a WATER WITHDRAWAL FACILITIES REGISTRATION PROGRAM form to Mr. Allan Luczyk, ODNR Division of Water for our Sandusky Bay water irrigation system.

Policy 27 – Fisheries Management

This policy calls for fisheries of the State of Ohio to be maintained and improved. Our proposed project will accomplish these two objectives in East Sandusky Bay. Recent studies show that Lake Erie coastal wetlands function as important fish habitat by exporting large quantities of fish, first to avian, piscine, and mammalian food chains through predation, and second to the lake as young-of-the-year sport and forage fish (Jude and Pappas 1992 *Fish Utilization of Great Lakes Coastal Wetlands.* Journal of Great Lakes Research 18(4):651-672). This research implied (1) that a wetland must be connected with the lake to promote and enhance efficient fish utilization of the high productivity of marshes, (2) that additional resilience is provided to species which spawn in wetlands since they can produce two cohorts (one in wetlands and one in the lake), and (3) that circulation initiated by fluctuating water levels is important in sustaining habitat diversity and productivity.

Your comments imply that our proposal to create a deep water habitat will be "without the presence of submersed aquatic vegetation." Figure 6 of our application clearly shows our intent to foster the establishment of submersed aquatic vegetation beds along the sides of the channel. No such beds occupied the bay bottom prior to the construction of the hydrologic channel.

Concern has also been expressed that coastal marshes such as those of East Sandusky Bay serve only as habitats for low-quality or undesirable fish species. However, the research Johnson (1989 *Lake Erie Wetlands: Fisheries Considerations*, in K. A. Krieger, ed., *Lake Erie Estuarine Systems: Issues, Resources, Status, and Management*, NOAA, Estuarine Program Office, Washington, DC, p. 257-274) shows that a diverse group of 46 species utilize Lake Erie coastal marshes, 33 of which are abundant or common—including: bigmouth buffalo (*Ictiobus cyprinellus*), quillback carpsucker (*Carpiodes cyprinus*), shorthead redhorse (*Moxostoma macrolepidotum*), white sucker (*Catostomus commersoni*), crappie (*Pomoxis* spp.), bluegill sunfish (*Lepomis macrochirus*), largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieui*), pumpkinseed (*Lepomis gibbosus*), rock bass (*Ambloplites rupestris*), gizzard shad (*Dorosoma cepedianum*), carp (*Cyprinus carpio*), emerald shiner (*Notropis atherinoides*), spottail shiner (*Notropis hudsonius*), grass pickerel (*Esox americanus*), black bullhead (*Ameiurus melas*), yellow bullhead (*Ameiurus natalis*), brown bullhead (*Ameiurus nebulosus*), channel catfish (*Ictalurus punctatus*), white perch (*Morone*

americana), white bass (*Morone chrysops*), yellow perch (*Perca flavescens*), and freshwater drum (*Aplodinotus grunniens*).

Our proposed project is consistent with OCMP's policy to maintain and improve Lake Erie fisheries in several ways. Firstly, it will create additional coastal marshes and will enhance water circulation to them. Secondly, it will provide a deep-water refugia for wetland fish species that would normally be stranded during low water level events when East Sandusky Bay is dewatered or frozen when the bay freezes to the bottom in winter. Thirdly, it will provide a direct conduit for fish to move between the lake and coastal marshes.

Policy 29 – Wildlife Management

Our proposed project is consistent with this OCMP policy by providing benefits to all wildlife, including nongame and endangered species. Your comments appear to be centered around waterfowl species and the notion that our intent is to create only waterfowl habitat. In our application we specify "avifauna habitat on a series of islands" and "deep water (~5 feet) fish and aquatic vegetation habitat in the restored hydrologic channel." Your points are well taken concerning waterfowl, particularly the Canada goose problem (a species for which breeding colonies were introduced to Ohio by ODNR, Division of Wildlife). We have observed numerous Canada goose nests on the barrier beach of Sheldon Marsh State Nature Preserve and the NASA breakwall, and we do not want to replicate your problem with this species. By specifying "avifauna habitat" our intention is to create a diverse habitat of aquatic plant zones on the inside slope of the islands, upland shrubs and trees on the crest, and beach flora on bay side. In this way we will be attracting a diverse community of birds to the islands and minimize unwanted species such as herring and ring-billed gulls and the Canada goose. We have already observed bald eagles (*Haliaeetus leucocephaus*), tundra swans (*Cygnus columbianus*), mallards (*Anas platyrhynchos*), great egrets (*Ardea albus*), and great blue herons (*Ardea herodias*) utilizing the island and hydrologic channel. Figure 12 of the application illustrates our concept of how the islands will appear once we have established native vegetation. As a comprehensive plant nursery, Barnes Nursery, Inc. has the labor, equipment, plant stock, and access to appropriate technical resourses to convert this concept into reality.

In developing our highly-praised composting operation, we worked with the U.S. Department of Agriculture (USDA), National Wildlife Research Center, Animal Damage Control Center (located at the NASA facility in Erie County, Ohio) to successfully minimize the aggregation of unwanted bird species. Plans are now being formulated to conduct research on our islands to insure that a similar result is obtained.

The USDA center has recommended that we request a permit for nest removal and egg destruction for unwanted bird species on the islands, particularly herring gull (*Larus argentatus*), ring-billed gull (*Larus delawarensis*), double-crested cormorant, (*Phalacrocorax auritus*), and Canada goose (*Branta canadensis*). This permit and control program would involve weekly monitoring (April-June) by USDA biologists to insure that the proper control mneasures are taken on the target species. With the approval of ODNR this program will prevent these unwanted bird species from establishing nesting colonies on the islands. Barnes Nursery is prepared to undertake this program in conjunction with USDA.

As a final note, we would like to advise you of our observations that relate to wildlife management for mammalian populations. The island we created north of the hydrologic channel appears to be a preferred habitat for mink (*Mustela vison*). Numerous mink dens have been found near the crest of the island. Here, the recently disturbed soil is easily burrowed into by these mustelids. Tracts of the white-tailed deer (*Odocoileus virginianus*) are also common on the island.

Thank you for this opportunity to respond to your concerns. We firmly believe that we have demonstrated that our proposed project is consistent with Ohio's Coastal Management Policies and that Barnes Nursery, Inc. and Sheldon Marsh State Nature Preserve can coexist in East Sandusky Bay and be mutually beneficial to each other. Please contact me if you have any questions or require additional information.

Sincerely.

Robert W. Barnes, President
Barnes Nursery, Inc.

cc: Michael G. Montone, U.S. Army Corps of Engineers
Laura A. Fay, Ohio EPA
David Kaiser, NOAA, Office of Coastal Resource Management
Kenneth C. Lammers, U.S. Fish and Wildlife Service
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